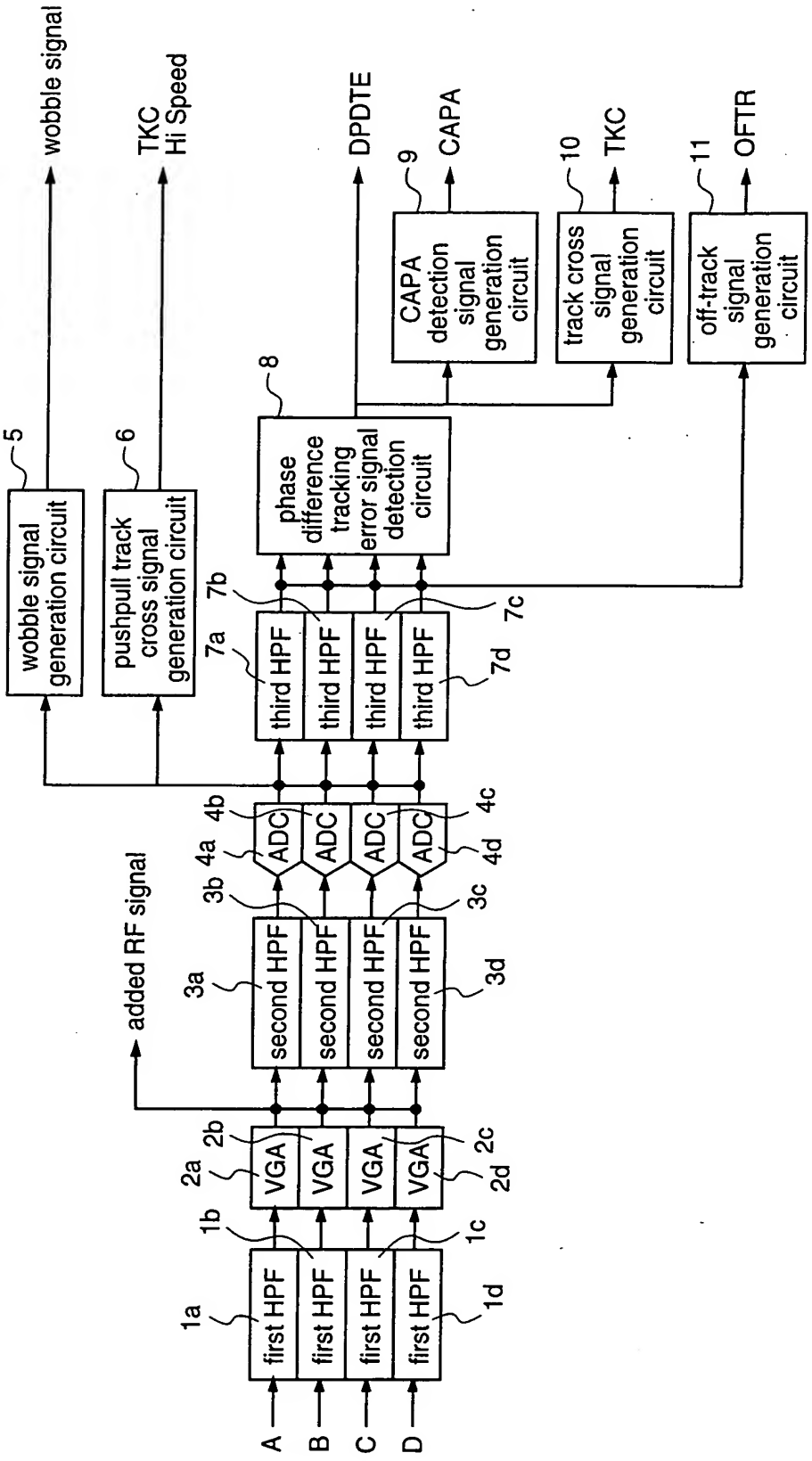

A
B
C
D
first HPF
1a
1b
1c
1d
VGA
2a
2b
2c
2d
added RF signal
second HPF
3a
3b
3c
3d
ADC
4a
4b
4c
4d
third HPF
7a
7b
7c
7d
wobble signal generation circuit
5
pushpull track cross signal generation circuit
6
phase difference tracking error signal detection circuit
8
CAPA detection signal generation circuit
9
track cross signal generation circuit
10
off-track signal generation circuit
11
wobble signal
TKC Hi Speed
DPDTE
CAPA
TKC
OFTR

Fig.1

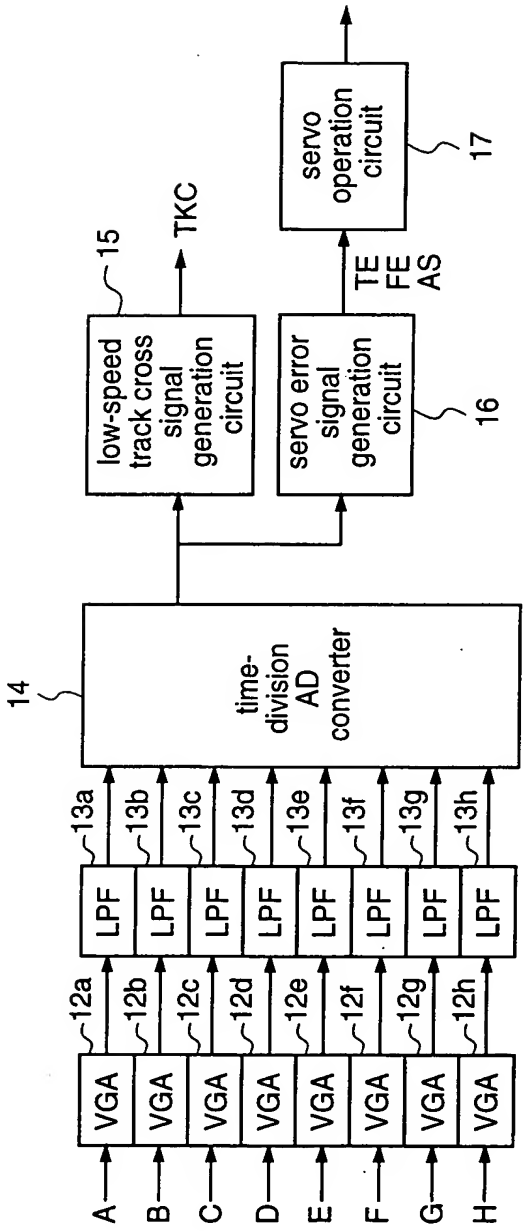

A
B
C
D
E
F
G
H
VGA
12a
12b
12c
12d
12e
12f
12g
12h
LPF
13a
13b
13c
13d
13e
13f
13g
13h
14
time-division AD converter
low-speed track cross signal generation circuit
15
TKC
servo error signal generation circuit
16
TE
FE
AS
servo operation circuit
17

Fig.2

Fig.3

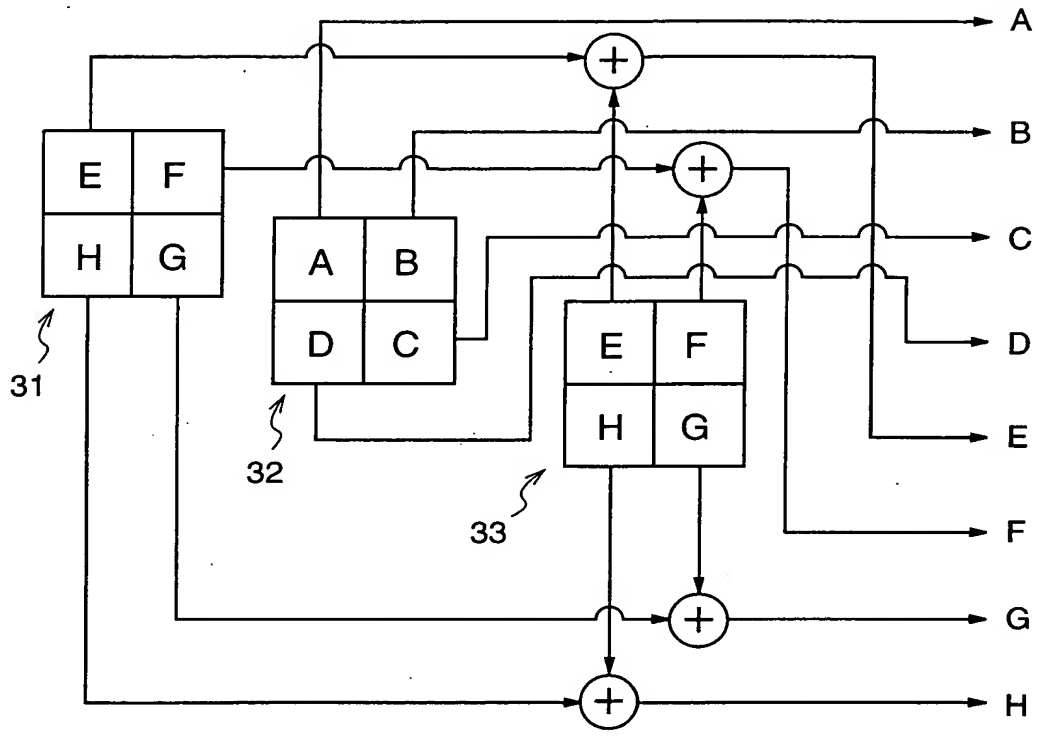


Fig.4(a)

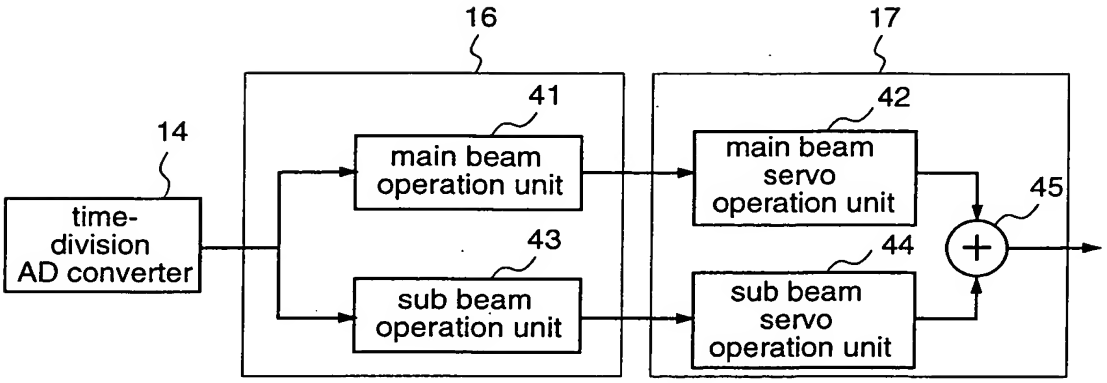

16
17
14
41
42
main beam operation unit
main beam servo operation unit
45
time-division AD converter
43
44
sub beam operation unit
sub beam servo operation unit

Fig.4(b)

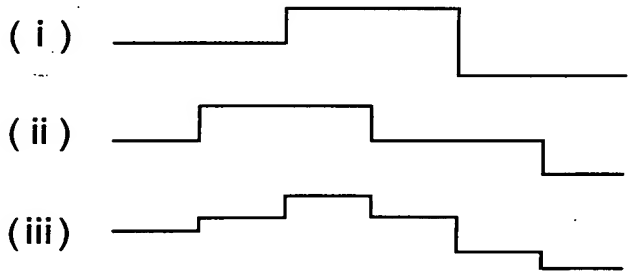

(i)
(ii)
(iii)

Fig.5(a)

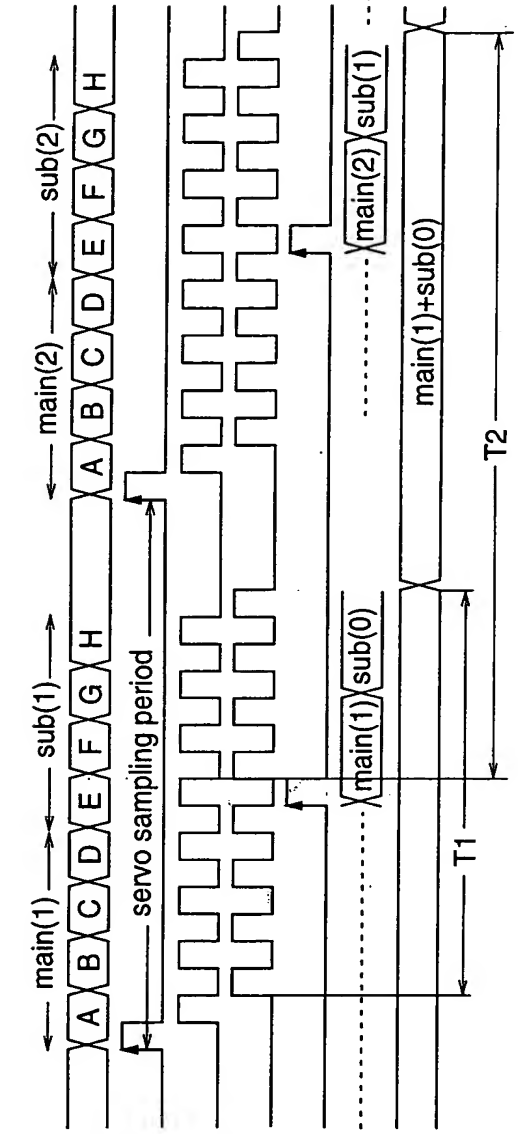
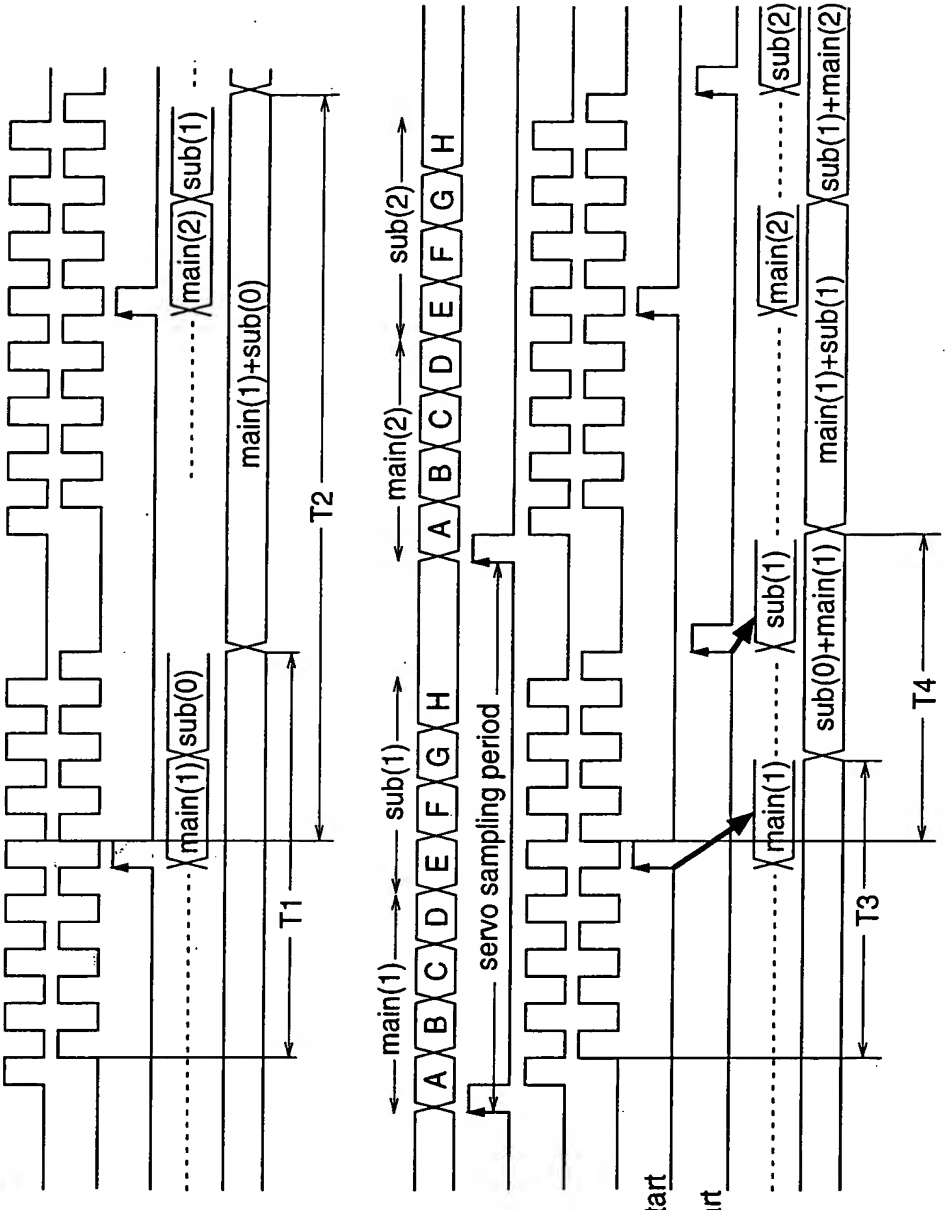

main(1)
sub(1)
main(2)
sub(2)
A B C D E F G H
servo sampling period
main(1)
sub(0)
main(2)
sub(1)
main(1)+sub(0)
T1
T2
(i) ch select
(ii) SEQ start
(iii) AS sample
(iv) AS convert
(v) CAL start
(vi) servo operation
(vii) driving output

Fig.5(b)


main(1)
sub(1)
main(2)
sub(2)
A B C D E F G H
servo sampling period
main(1)
sub(1)
main(2)
sub(2)
sub(0)+main(1)
main(1)+sub(1)
main(1)+main(2)
T3
T4
(i) ch select
(ii) SEQ start
(iii) AS sample
(iv) AS convert
(v) main CAL start
(vi) sub CAL start
(vii) servo operation
(viii) driving output

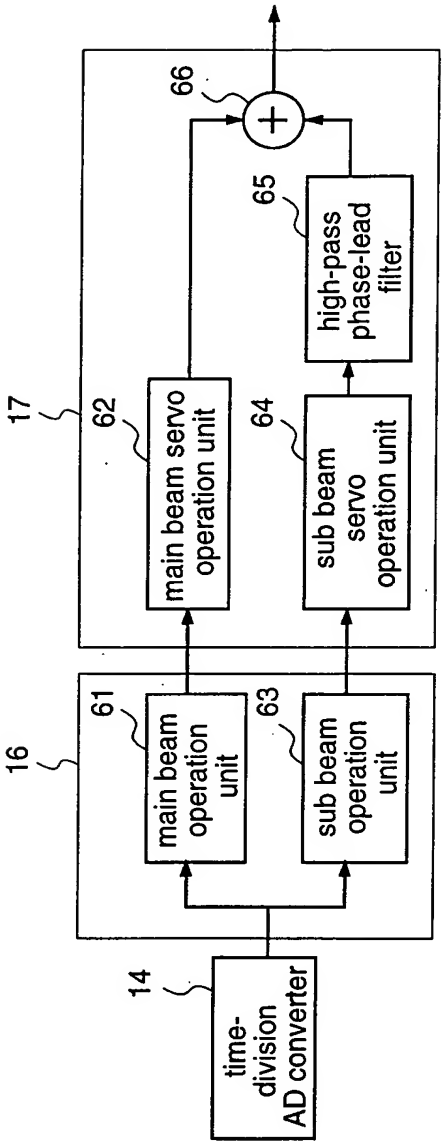

14
time-division AD converter
16
61
main beam operation unit
63
sub beam operation unit
17
62
main beam servo operation unit
64
sub beam servo operation unit
65
high-pass phase-lead filter
66

Fig.6

Fig.7(b)

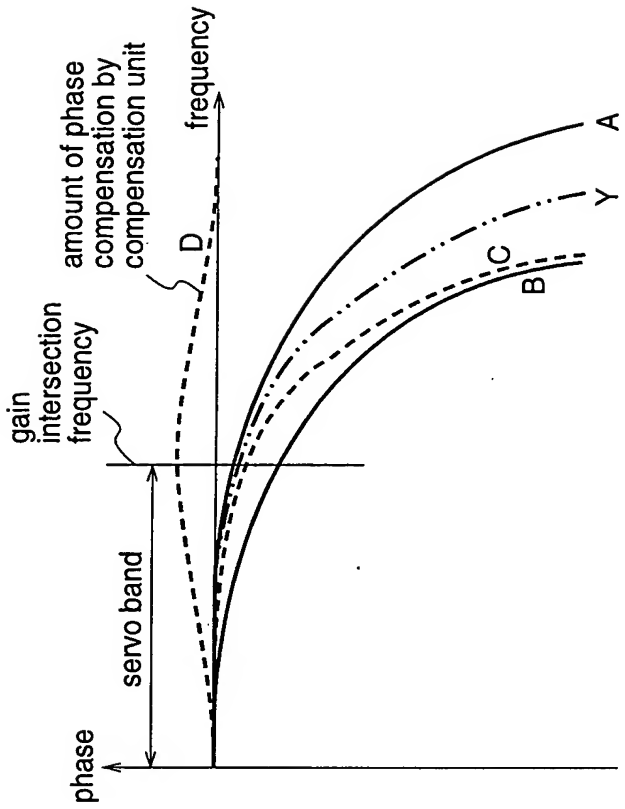

amount of phase compensation by compensation unit
frequency
A
Y
D
C
B
gain intersection frequency
servo band
phase

Fig.7(a)

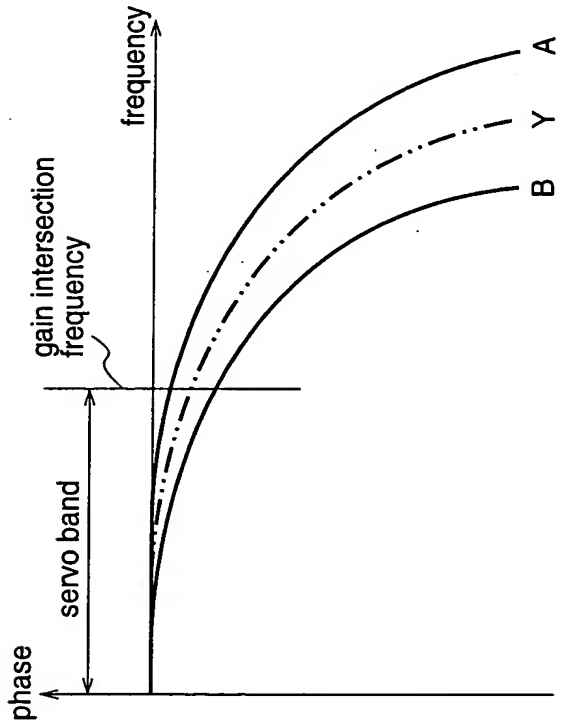

frequency
A
Y
B
gain intersection frequency
servo band
phase

Fig.8

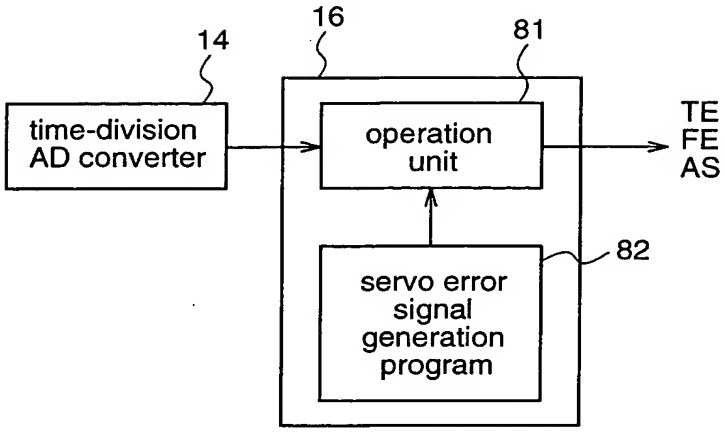
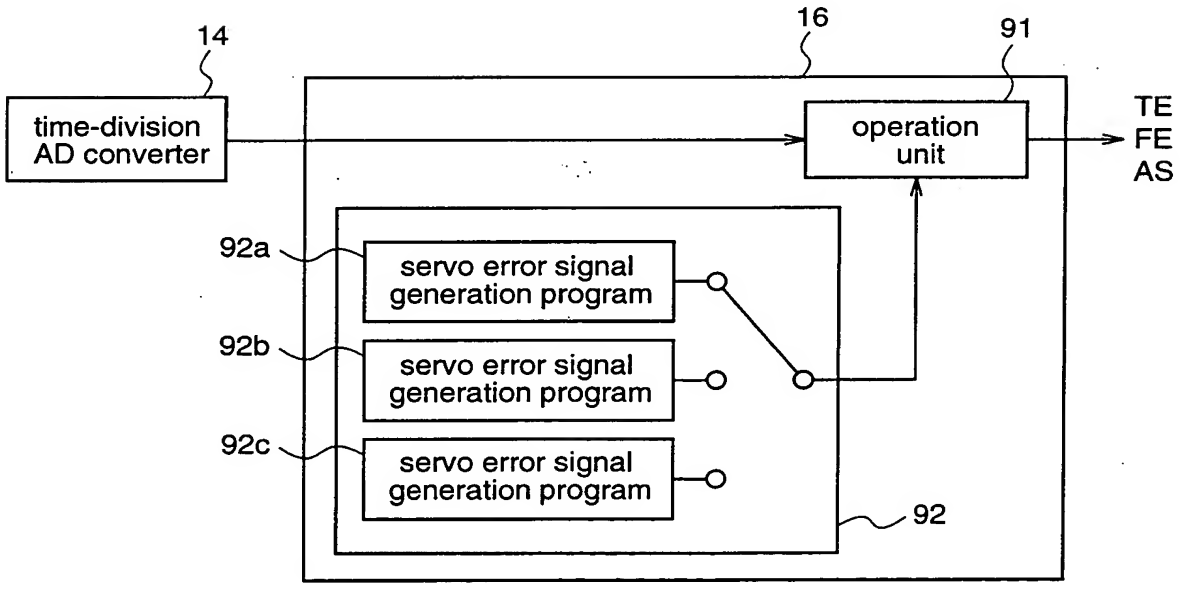

14
16
81
time-division AD converter
operation unit
TE
FE
AS
82
servo error signal generation program

Fig.9


14
16
91
time-division AD converter
operation unit
TE
FE
AS
92a
servo error signal generation program
92b
servo error signal generation program
92c
servo error signal generation program
92

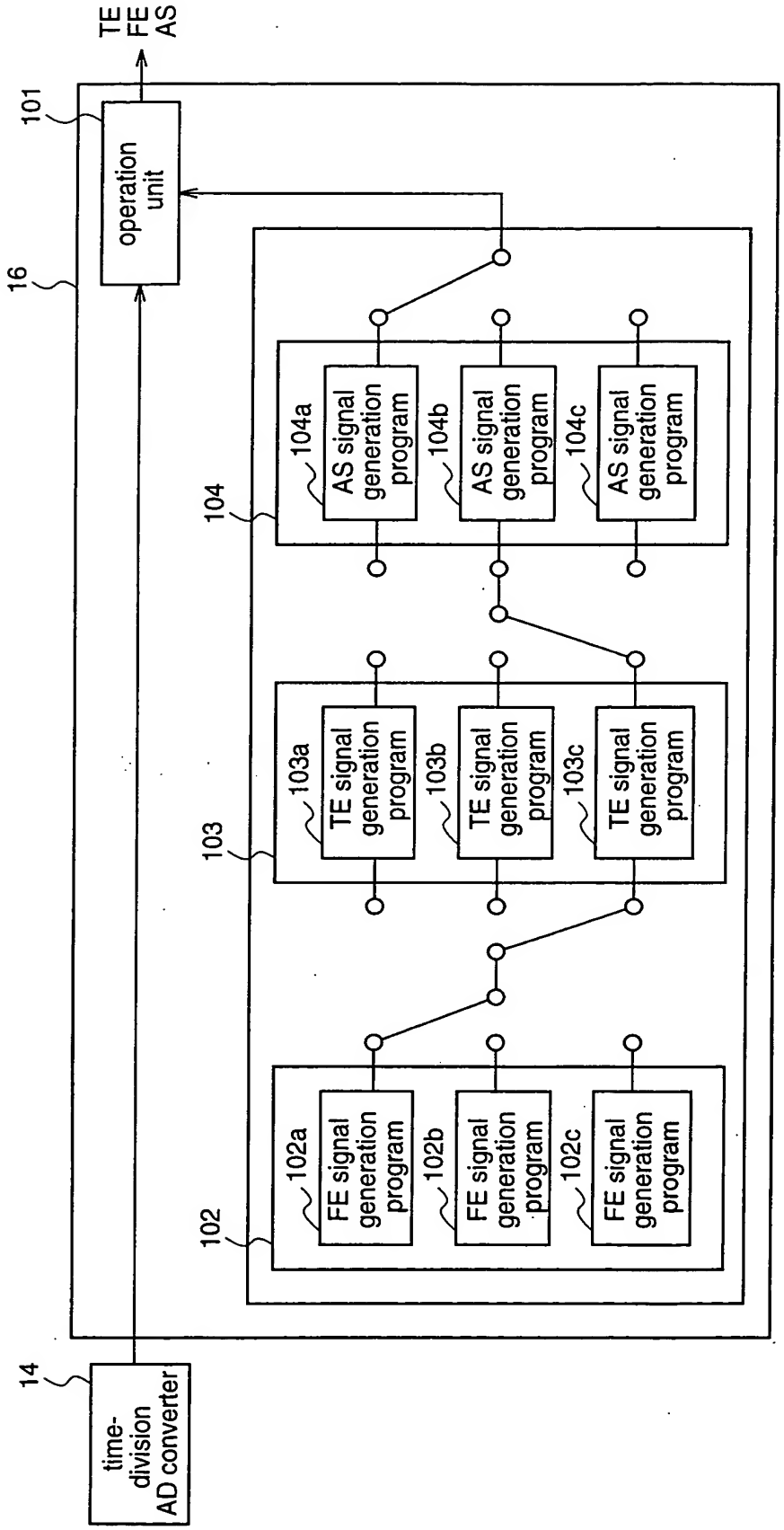
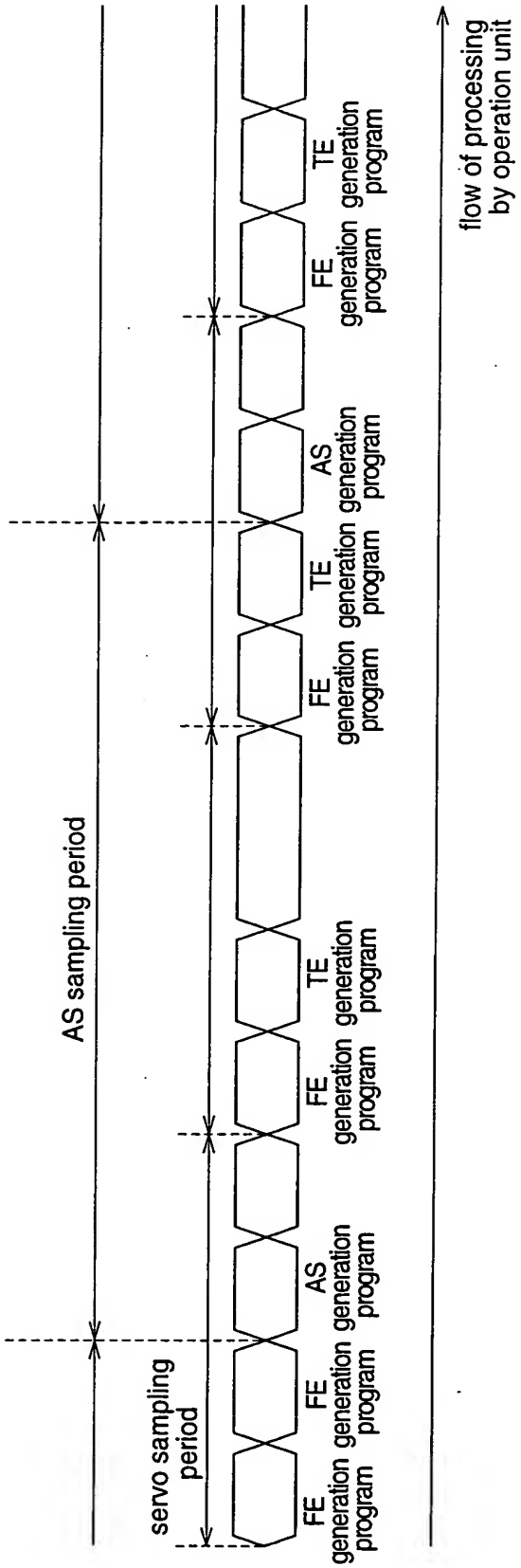

TE
FE
AS
101
operation unit
16
104
104a
AS signal generation program
104b
AS signal generation program
104c
AS signal generation program
103
103a
TE signal generation program
103b
TE signal generation program
103c
TE signal generation program
102
102a
FE signal generation program
102b
FE signal generation program
102c
FE signal generation program
14
time-division AD converter

Fig.10

Fig.11


AS sampling period
servo sampling period
FE generation program
AS generation program
TE generation program
flow of processing by operation unit

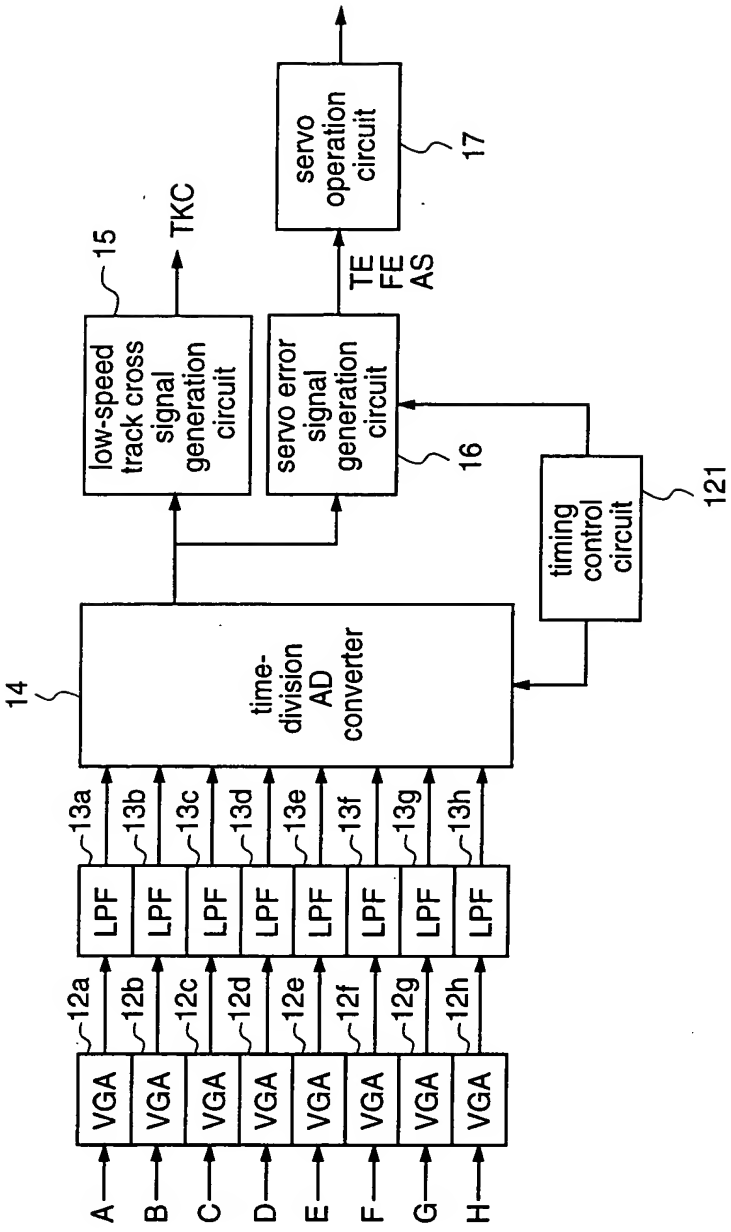

A
B
C
D
E
F
G
H
VGA
12a
12b
12c
12d
12e
12f
12g
12h
LPF
13a
13b
13c
13d
13e
13f
13g
13h
14
time-division AD converter
timing control circuit
121
servo error signal generation circuit
16
low-speed track cross signal generation circuit
15
TKC
TE
FE
AS
servo operation circuit
17

Fig.12

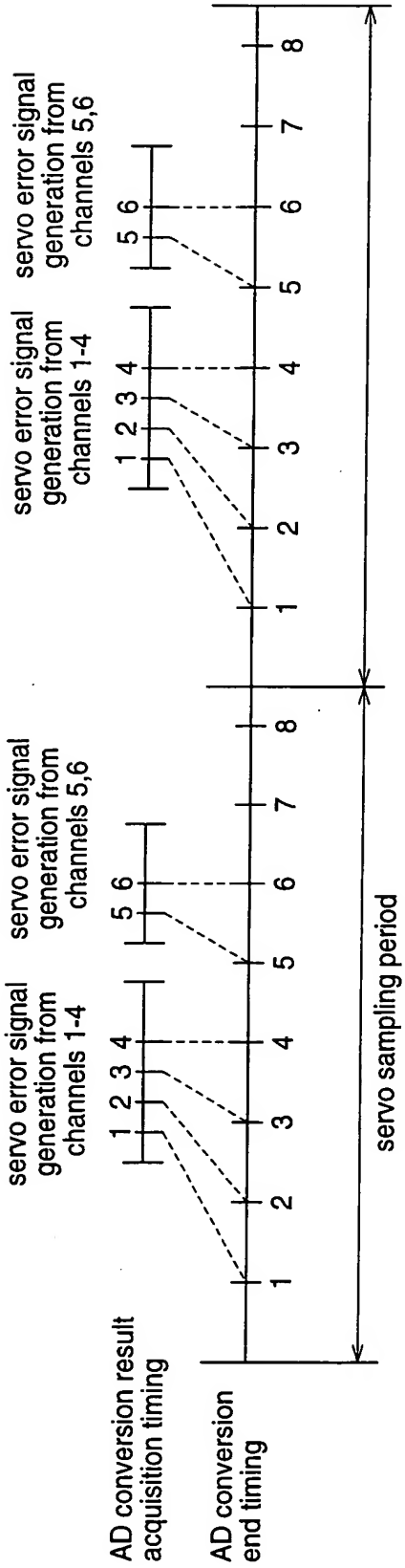

servo error signal generation from channels 1-4
servo error signal generation from channels 5,6
servo error signal generation from channels 1-4
servo error signal generation from channels 5,6
AD conversion result acquisition timing
AD conversion end timing
servo sampling period
1 2 3 4 5 6 7 8

Fig.13

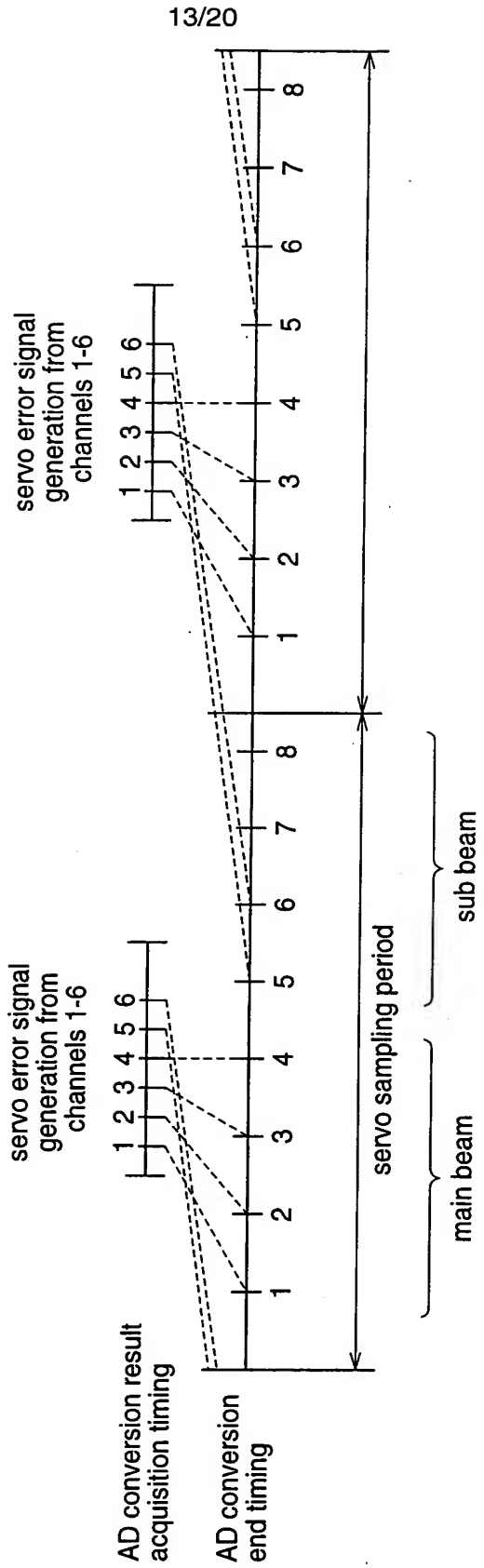
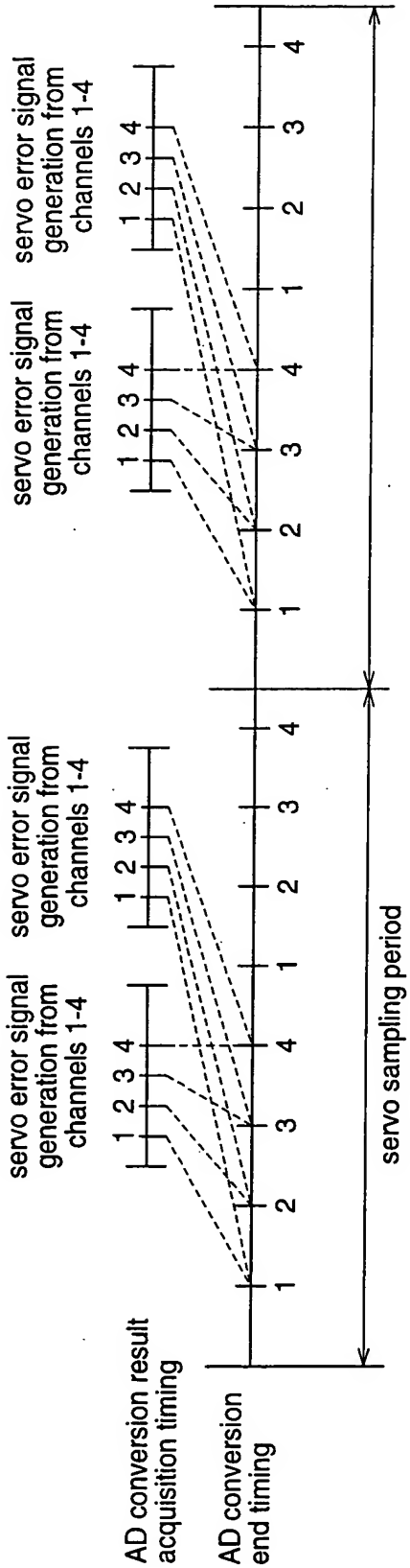

servo error signal generation from channels 1-6
1 2 3 4 5 6
servo error signal generation from channels 1-6
1 2 3 4 5 6
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8
AD conversion result acquisition timing
AD conversion end timing
servo sampling period
main beam
sub beam

Fig.14

Fig.15


servo error signal generation from channels 1-4
servo error signal generation from channels 1-4
servo error signal generation from channels 1-4
servo sampling period
AD conversion result acquisition timing
AD conversion end timing
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4

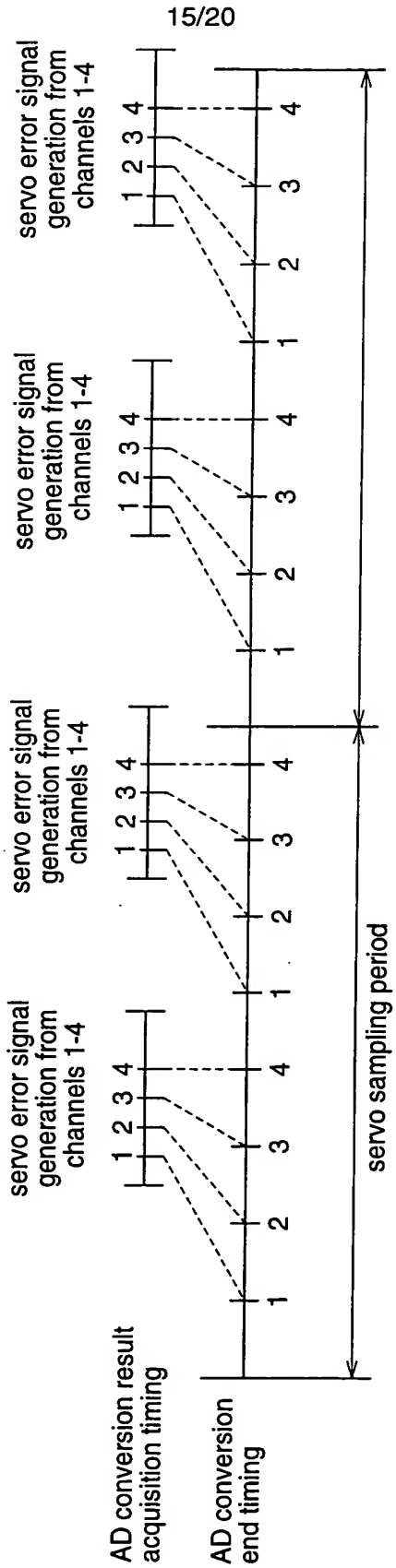

servo error signal generation from channels 1-4
servo error signal generation from channels 1-4
servo error signal generation from channels 1-4
servo error signal generation from channels 1-4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
servo sampling period
AD conversion result acquisition timing
AD conversion end timing

Fig.16

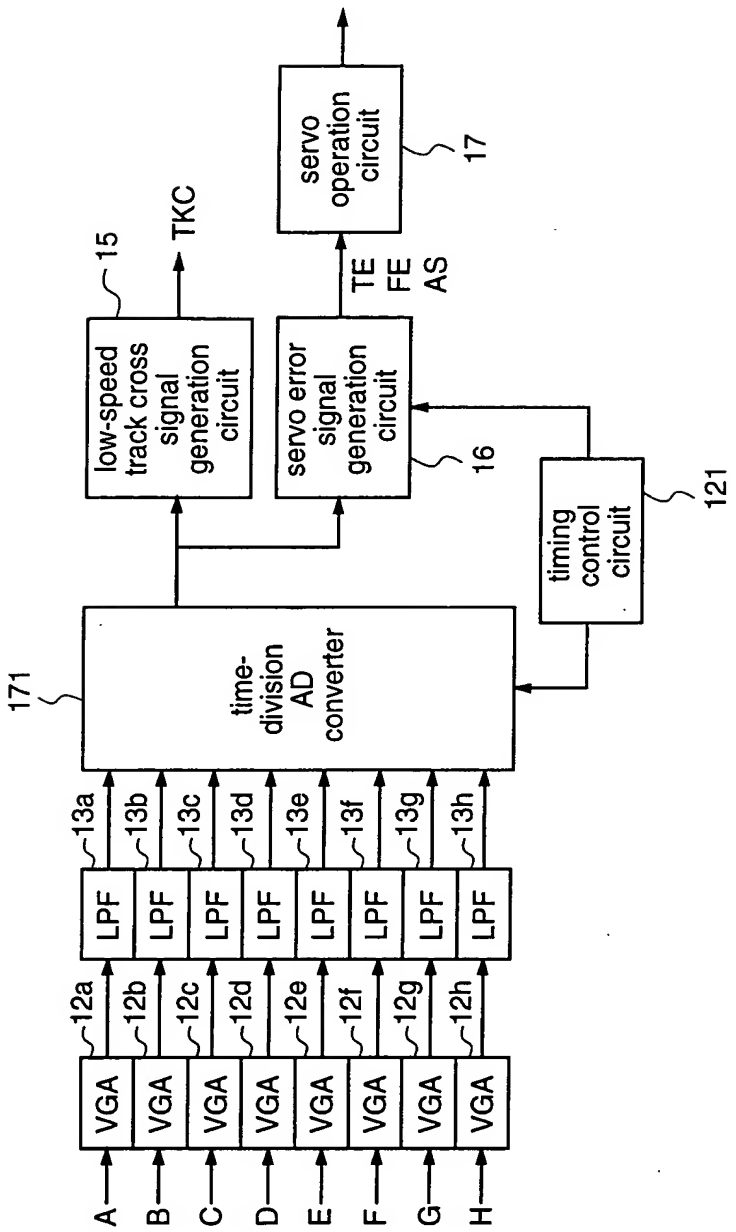
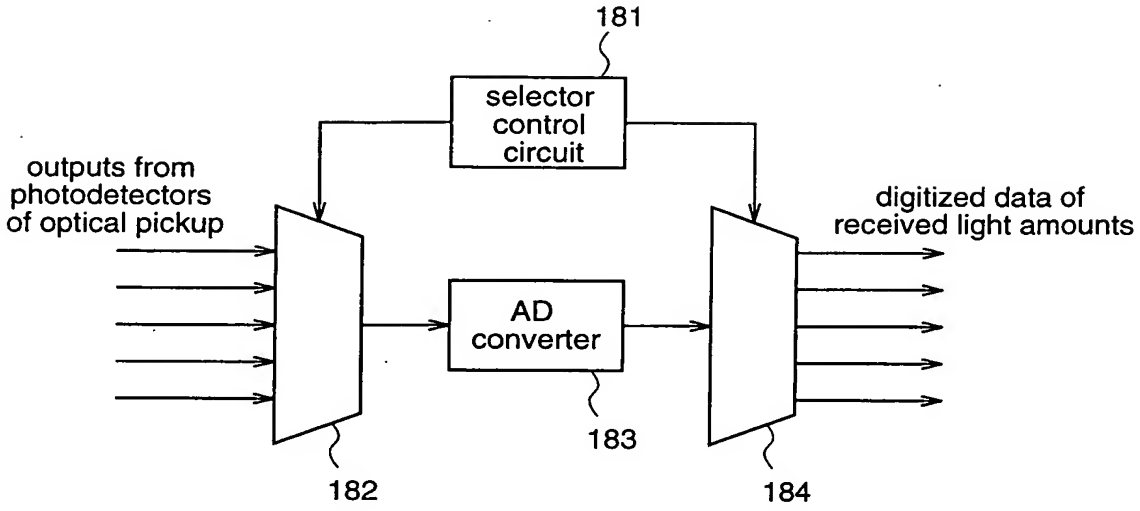

A
B
C
D
E
F
G
H
VGA
12a
12b
12c
12d
12e
12f
12g
12h
LPF
13a
13b
13c
13d
13e
13f
13g
13h
171
time-division AD converter
timing control circuit
121
servo error signal generation circuit
16
low-speed track cross signal generation circuit
15
TKC
TE
FE
AS
servo operation circuit
17

Fig.17

Fig.18


181
selector control circuit
outputs from photodetectors of optical pickup
digitized data of received light amounts
AD converter
183
182
184

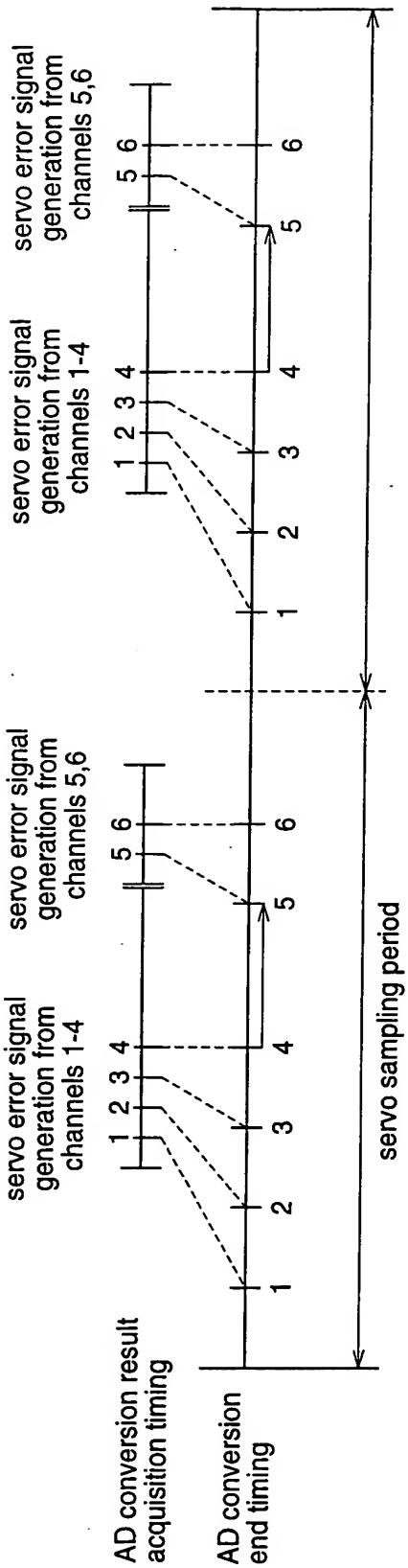

servo error signal generation from channels 1-4
servo error signal generation from channels 5,6
servo error signal generation from channels 1-4
servo error signal generation from channels 5,6
servo sampling period
AD conversion result acquisition timing
AD conversion end timing
1
2
3
4
5
6

Fig.19

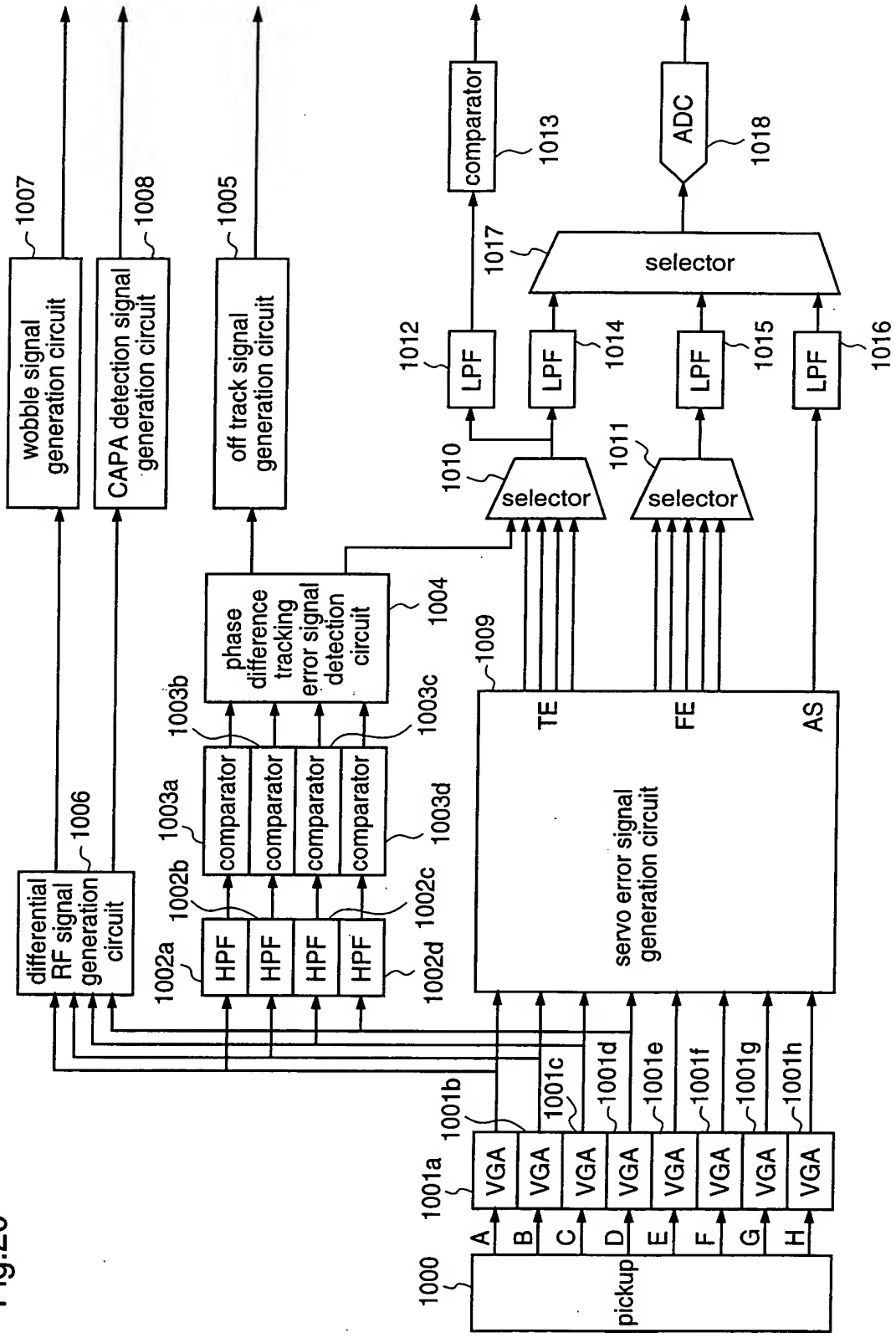

1000
pickup
A
B
C
D
E
F
G
H
1001a
VGA
1001b
1001c
1001d
1001e
1001f
1001g
1001h
1002a
HPF
1002b
1002c
1002d
1003a
comparator
1003b
1003c
1003d
1004
phase difference tracking error signal detection circuit
1005
off track signal generation circuit
1006
differential RF signal generation circuit
1007
wobble signal generation circuit
1008
CAPA detection signal generation circuit
1009
servo error signal generation circuit
TE
FE
AS
1010
selector
1011
selector
1012
LPF
1013
comparator
1014
LPF
1015
LPF
1016
LPF
1017
selector
1018
ADC

Fig.20

Fig.21

TE=(TE+)*(1−a)−(TE−)*(1+a)	
(a)	TE+ = A , FE− = B
(b)	TE+ =(A+D), FE− =(B+C)
(c)	TE+ =(A+D)−k(E+H), TE− =(B+C)−k(F+G)
(d)	TE+ =(phase difference AB), TE− =(phase difference CD)

Fig.22

FE=(FE+)*(1−a)−(FE−)*(1+a)	
(a)	FE+ =E, FE− =F
(b)	FE+ =H, FE− =G
(c)	FE+ =A+C, FE− =B+D
(d)	FE+ =(A+C)−k(F+H), FE− =(B+D)−k(E+G)

Fig.23

AS=A+B+C+D